

# Review of the Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement 2002

SECTION 13-49 THROUGH 13-81 OF THE ECONOMIC APPENDIX (I)

RECREATIONAL BENEFITS OF BREACHING THE FOUR LOWER SNAKE RIVER DAMS

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### **About Earth Economics**

Earth Economics is a non-profit located in Tacoma, Washington, dedicated to researching and applying the economic solutions of tomorrow, today. Earth Economics provides robust, science-based, ecologically sound economic analysis, policy recommendations and tools to positively transform regional, national and international economics, and asset accounting systems. Earth Economics has extensively studied the economic benefits of outdoor recreation in Washington State, producing reports at the state, county, city, and agency level.

## **Glossary of Terms Used in this Study**

*Consumer Surplus* – An economic measure of consumer satisfaction. In this study it refers to the difference a person is willing to pay for engaging in an outdoor recreational activity and actual expenditures incurred.

*Economic Activity* - Economic exchanges in a region's economy, which involve the production, distribution and consumption of goods and services.

*Economic Benefit* – The total increase in social welfare, including market and non-market values.

*Economic Impact* – The net changes in economic activity associated with the industry analyzed (i.e. outdoor recreation economy). For example, an impact accounts for new dollars flowing into a defined regional economy as a result of outdoor recreation opportunities.

*Ecosystem Service Value* – The measurement of economic benefits that people derive from ecosystems, many times expressed as non-market values or market value equivalents.

*National Economic Development (NED)* – NED impacts reflect the net effects of a proposed action upon the nation. Economic gains achieved by one region at the expense of another region are not measured as NED benefits.

*Passive Use Values*- The value people place on goods, services, or ecosystems that is not associated with a consumptive use of it.

*Recreation-related Expenditures* – Money spent on outdoor recreation, including equipment, travel and lodging, entrance fees, and food and beverages, among others. These expenditures are assumed to be made within Washington.

*Regional Economic Development* – RED addresses changes in regional economic activity that would result from each alternative. Effects are addressed in terms of changes to regional business transactions, employment, and income.

*Survey-based Valuation Methodologies*- Monetary value estimates derived through surveys administered to a potentially impacted population (or potential beneficiaries). Surveys must follow economic frameworks and structure to ensure that results are valid.

*Travel Cost Method (TCM)*- A non-market valuation method that uses variations in travel cost to trace out the recreation demand curve, from which the consumer surplus is calculated. Recreation areas attract tourists whose value placed on that area must be at least what they were willing to pay to travel to it.

*Willingness to Pay (WTP)*- Value elicited by potential consumers in response to hypothetical scenarios being valued. Values are expressed as willingness to pay for a given service or state of the world and are validated to ensure follow-through should a payment be required.

## Introduction

Earth Economics has been commissioned to review Appendix I, section 3.2 of the “Lower Snake Feasibility Report/Environmental Impact Statement”<sup>1</sup> (LSRFR) completed in 2002 as well as John Loomis’ original report to the Walla Walla District (NWW) of the United States Army Corps of Engineers (USACE) “Recreation and Passive Use Values from Removing the Dams on the Lower Snake River to Increase Salmon”<sup>2</sup> published in 1999. Loomis’ report offers eight different estimates for the value of recreation based on consumer surplus measures using varying methodologies and assumptions.

These eight potential value estimates and the values chosen by the NWW for representing these results are summarized in the tables below. The report to the NWW does not provide all eight estimates, but instead provides the middle estimates for visitation with low and high national economic development (NED) values. The numbers with borders are the values the NWW uses in their point estimate for recreation. Using these values, the point estimate used by NWW in 2002 for recreation is \$73.128M (1998 dollars) annually.

Table 1. Recreation Values from LSRFR<sup>1</sup> (Values in Millions, 1998 USD)

Summary of General Recreation	1	Low NED	High Ned
General Recreation			
Reservoir Recreation	\$31.6		
Middle Use Estimate 1		\$36.9	\$192.7
Middle Use Estimate 2		\$59.5	\$310.5
Recreational Fishing		\$45.228	
	Point Estimate	\$73.128	

The following table shows Loomis’ original values presented to the NWW. Loomis estimates four different visitation levels in the report (low, middle, middle-high, and high). However, Loomis provides only one middle estimate in his final annualized table. The cells with black borders are John Loomis’ suggested estimates for the value of recreation. Using these values, the final point estimate for recreation is between \$95M and \$349M (1998 dollars) annually using low and high NED values, respectively. These numbers are significantly higher than the numbers used by the NWW.

Table 2. Recreation Values from Loomis Recreation<sup>2</sup> (Values in Millions, 1998 USD)

Summary of General Recreation	1	Low NED	High Ned
General Recreation			
Reservoir Recreation	\$31.6		
Low Use Estimate		\$36.18	\$150.12
Middle Use Estimate		\$80.85	\$335.53
High Use Estimate		\$367.18	\$1,523.74
Recreational Fishing		\$45.228	
	Point Estimate	\$94.478	\$349,158

Our review of the methodologies and underlying assumption concludes that the value estimates chosen to represent general river recreation expected in a free flowing Lower Snake River are not the most methodologically sound of all the estimates provided and the underlying assumptions behind the chosen estimates are not necessarily the most accurate. These estimates rely on two assumptions about visitors. The first assumption made is in regards to how survey respondents and non-respondents are assumed to behave given their answers to a well-conducted survey. The current point estimate assumes visitation only by survey respondents that indicated they ‘definitely’ or ‘probably’ would visit, but assumes that survey non-respondents would not visit. This assumption is referred to as “Middle Estimate 2”. The second assumption deals with whether low or high national economic development (NED) values are used, which is based on how travel costs are measured. Travel costs are either measured by using survey respondents’ reported costs of travel (e.g., transportation, lodging, food, etc.) or solely assumed travel costs associated with transportation to and from the river. The NWW estimates river recreation based strictly on transportation costs, or the “Low NED” value.

This analysis recommends the point estimate for recreation on a free-flowing Lower Snake River to be \$956M (1998 dollars) annually, assuming an annual average equivalent<sup>1</sup> over 100 years at a 6.875% discount rate. This estimate assumes visitation by survey respondents stating that they ‘definitely’ or ‘probably’ would visit, applying this ratio to non-responders, and high NED values derived from a well-conducted survey. This methodology is applied to all survey respondents for years 1 through 4. For the remaining years (5-100), we assume that California survey respondents would only visit if they selected ‘definitely yes’ as a response, assuming zero visitation for ‘probably’ (yes), but applies this ratio to non-respondents. ‘Definitely’ or ‘probably’ (yes) respondents are still assumed to visit for Washington, Idaho, Montana, and Oregon respondents for years 5 through 100. Restoration projects in Washington have shown that there is an immediate increase in visitation after restoration projects, but this high level of visitation is not sustained in the long run.<sup>3</sup>

The first chapter of this report will review and explain in simple terms the methodologies used by Dr. Loomis<sup>2</sup> for calculating recreational benefits under two scenarios; recreation with the dam and recreation without. Next, Earth Economics will provide expert opinion on the point estimate that is believed to be the most representative of the study area with a dam removal scenario. Finally, Earth Economics will identify areas on how Dr. Loomis’ work can be

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<sup>1</sup> Annual average equivalent is the average cost or benefit of owning an asset over its entire life.

expanded to current best practices, such as the discount rate and the inclusion of ecosystem service values.

## **Overview of the Current Lower Snake River Feasibility Report**

The first section of this report will review Appendix I, section 3.2 of the “Lower Snake Feasibility Report/Environmental Impact Statement”<sup>1</sup> completed in 2002 as well as Dr. John Loomis’ original report to the Army Corps of Engineers Walla Walla District “Recreation and Passive Use Values from Removing the Dams on the Lower Snake River to Increase Salmon”<sup>2</sup> published in 1999. The purpose of reviewing this literature is to assess the methodology and assumptions behind the different recreation values given current state of the art in valuation methods.

Section 3.2 of Appendix I of the “Lower Snake Feasibility Report/Environmental Impact Statement” (LSRFR) provides national economic development (NED) values associated with (then) current recreation occurring at the dam reservoirs and estimated net changes in recreation that would result from the removal of the four Lower Snake River Dams.

## **Assumptions about Visitation Rates and Incurred Expenditures**

The LSRFR study estimates the value that people put on recreational opportunities by administering a survey to current reservoir users and potential users of a free-flowing Lower Snake River. The survey was administered in Washington, Idaho, Oregon, Montana, and California. (It does not include international visitors.) This survey was used to estimate the number of visitors and the estimated expenditures that would be made during the trip. The expenditures are used to construct a demand curve from which consumer surplus values are calculated to reflect the non-monetary welfare that recreational visitors get.

The LSRFR provides four estimates of the value of general river recreation based on the findings of the survey. These results have been annualized and averaged over 100 years in the table below. Out of the four provided estimates, the LSRFR chose to use an average annual equivalent of \$59.5M (1998 dollars) in benefits per year over 100 years for general recreation benefits with dam removal. For a detailed description on economic benefits, beneficiaries and NED values, please see Appendix A.

Each of the values given in the table below is based on two different pairs of assumptions in relation to assumed visitation rates and willingness to pay (WTP) estimates derived from the surveys. The middle estimates are visitation estimates, while the NED values are based on low and high recreational values, changing in relation to the assumed expenditures.

Table 3. Recreation Benefits with Dam Removal (Values in Millions, 1998 USD @ 6.875%) (Table 3.2-13, LSRFR)

	Low NED	High NED
Middle Estimate 1	\$36.9	\$192.7
Middle Estimate 2	<b>\$59.5</b>	\$310.5

### Low and High NED Values

**Low NED:** Assumes lower bound estimate of recreational values. This estimate uses a cost per mile estimate obtained from the reservoir fishing analysis for the assumed total expenditures.

**High NED:** Assumes upper bound estimate of recreational values. This estimate is based on the findings from the survey on the estimated expenditures incurred to travel to a free-flowing Lower Snake River. These expenditures include more than car-related expenditures.

A low NED value was chosen because the survey respondents reported trip costs higher than average expenditures. The Low NED value ignores the findings of the survey and uses the cost-per-mile price variable in the travel cost method (TCM) general river recreation demand function. In our opinion, this cost-per-mile measure is a very low estimate of people's value of recreation.

### Estimating Visitation Rates

**Middle Estimate 1:** Assumes only survey respondents that indicated they would 'definitely' visit would visit and assumes that the rest of respondents would not visit including those that said they would 'probably' visit. It also assumes that that households that did not respond to the survey would visit at the same rate as households that responded to the survey.

**Middle Estimate 2:** Assumes that survey respondents that indicated that they would 'definitely' or 'probably' would visit would actually visit, but assumes that households that did not respond to the survey would not visit.

The LSRFR recognizes that assuming zero visitation from 'probably' (yes) respondents is unrealistic and hence uses the Middle Estimate 2 as the NWW point estimate. However, this point estimate assumes non-respondents would not recreate in the free flowing river at all, which is highly unlikely. Both middle estimates are quite conservative with at least one of their assumptions. In John Loomis' original report<sup>2</sup> to the NWW, four additional values are provided; a low visitation estimate and a high visitation estimate paired with low and high NED values. Loomis' low estimates assume only respondents that said they would definitely visit would visit, with zero visitation from both probable and non-respondents. The high estimates assume visitation by 'definitely' and 'probably' (yes) respondents, and applies this ratio to non-respondents. These estimates were not considered at all.

## Recommended Point Estimate

Survey-based methodologies for estimating visits to a recreational area are widely used. There has been extensive research on how to interpret survey responses through both empirical and theoretical research. It is safe to assume that a non-response to a survey does not necessarily imply a disinterest in the behavior being researched (in this case river recreation). A number of factors can affect a person’s willingness to respond to a survey; ranging from distrust of the survey to more practical reasons like time constraints or unavailability.<sup>4, 5</sup> In general, current theory for using survey methodologies has shown that there is not a strong relationship between non-responses and survey biases.<sup>6</sup>

The LSRFR does not include the lower and upper bound estimates provided by Loomis’ original recreation report.<sup>2</sup> These estimates are as follows:

**Lower Estimate:** Assumes just households that indicated they would ‘definitely’ visit with dam removal and assuming zero visitation from survey non-respondents.

**Upper Estimate:** Assumes households that indicated they ‘definitely’ or ‘probably’ would visit actually visit and assuming that all households would visit at the rate of survey respondents.

It has been found that there is no strong relationship between a survey’s nonresponse rate and the expected behavior of that respondent. This illustrates that assuming zero visitation from non-respondents can drastically misrepresent actual visitation.<sup>6</sup> It is also conservative to assume only respondents stating they would ‘definitely visit’ would visit. Empirical research suggests that too many ‘yes’ responses were being recoded as ‘no’s’ across survey-based studies if only completely certain ‘yes’ responses were retained.<sup>7</sup> It has also been found that the estimation of median WTP would be biased if the ‘don’t know’ respondents were simply thrown out or recoded as ‘No’s’.<sup>8</sup> We believe that it is safest to assume that visitation is best predicted by assuming visitation by ‘definitely yes’ and ‘probably yes’ respondents and assuming zero visitation by ‘definitely No’ and ‘probably No’ respondents. The visitation estimates by respondents would be assumed for non-respondents as well. This rate would then be applied to all households within the region. Even though some ‘probably yes’ respondents may not visit, there will also be ‘probably no’ respondents that do visit.

Table 4. Would You Visit a Free-Flowing Lower Snake River? (Table 2 Loomis Recreation)<sup>2</sup>

	Local Counties	Res of ID, Or, WA	MT	CA
Definitely Yes	14%	10%	5%	3%
Probably Yes	28%	24%	15%	21%
Probably No	43%	50%	60%	51%
Definitely No	16%	17%	20%	58%

The use of the high NED value is also recommended. The low NED values ignore the findings of the survey and assume very low value placed on free flowing river recreation by using the 19 cent cost-per-mile estimate. This estimate makes values even smaller given that most visitors are assumed to be local. The LSRFR states that for reservoir recreation, most users will be local and therefore take shorter trips, typically of a day or less. The TCM used relies upon just transportation costs incurred traveling to and from the reservoirs, and does not include other costs, such as lodging. There is evidence that for recreation, survey-derived WTP estimates are not statistically different from WTP estimates derived from actual behavior-based methods.<sup>9</sup> This evidence shows that using the survey data to calculate consumer WTP can be statistically significant.

Table 5. Recreation Benefits with Dam Removal (Values in Millions, 1998 USD @6.875%) as presented in the Loomis Recreation Report (Table 8A)<sup>2</sup>

	Low NED	High NED
Low Use Estimate	\$36.18	\$150.12
Middle Use Estimate	\$80.85	\$335.53
High Use Estimate	\$367.18	\$1,523.74

### ***Adjusting for California’s Large Visitor Contribution***

As was the conclusion in the LSRFR, it is unlikely that Californian’s would be able to sustain the high visitation rate as shown in the surveys. Assuming ‘definitely yes’ and ‘probably’ survey respondents would visit would yield 22 million visitors per year, 82% of the total visitors. To adjust for this, starting in year 5, it is assumed that only ‘definitely yes’ respondents from California are assumed to visit. Adjusting for this, only 3.5 million visitors will come from California, or 40% of visitors in years 5-100. The following table illustrates the projected visitation to the Lower Snake River following restoration for all visitor origins. Underlined visitor days supplied are values that are restricted from a capacity standpoint.

Activity	Visitor Days Demanded		Visitor Days Supplied			
	Years 1-4	Years 5-100	Years 1-4	Years 5-9	Years 10-19	Years 20-100
Jet Boating, Jet Skiing	1,066,599	327,362	<u>213,320</u>	<u>163,681</u>	<u>229,153</u>	327,362
Raft/Kayak/Canoe	3,452,425	1,059,623	<u>1,035,728</u>	<u>529,811</u>	<u>847,698</u>	1,059,623
Swimming	3,396,283	1,042,392	<u>679,257</u>	<u>416,957</u>	1,042,392	1,042,392
Picnic/Primitive Camping*	7,859,177	2,412,149	<u>167,400</u>	<u>167,400</u>	<u>558,000</u>	<u>558,000</u>
Developed Camping*	4,378,681	1,343,910	<u>219,294</u>	<u>219,294</u>	<u>438,588</u>	<u>438,588</u>
Hike and Mountain Bike	6,792,578	2,084,786	<u>5,434,062</u>	2,084,787	2,084,787	2,084,787
Hunting	1,122,741	344,593	<u>561,371</u>	<u>275,675</u>	344,593	344,593
<b>Total</b>	<b>28,068,497</b>	<b>8,614,819</b>	<b><u>8,310,431</u></b>	<b><u>3,857,604</u></b>	<b><u>5,545,211</u></b>	<b><u>5,855,345</u></b>

\*Visitation restricted by number of sites available, also underlined.

Adjusting for California’s visitation after year 4, the AAEV for general recreation is therefore \$942.17M (1998 dollars) if we continue to assume a NED value of \$160 per visitor, and \$180.66M (1998 dollars) if we assume a NED value of \$31 per visitor.

	Low NED	High Ned
Low Use Estimate	\$36.18	\$150.12
Middle Estimate 1 (LSRFR)	\$36.90	\$192.70
Middle Estimate 2 (LSRFR)	\$59.50	\$310.50
California Adjusted Estimate	\$180.66	\$942.17
High Use Estimate	\$367.18	\$1,523.74

### Final Point Estimate

After adjusting for California’s survey responses, we recommend using NED benefits for general river recreation of \$942M (1998 dollars) per year. This estimate conforms to current and established best practices on survey-derived data.<sup>10</sup> Assuming general river recreation benefits of \$942M (1998 dollars), the new point estimate for annual average equivalent over 100 years at a 6.875% discount rate is now \$955.8M (1998 dollars).

Table 6. Summary of Recreation @6.875%, (Values in Millions, 1998 USD) (Updating Table 3.2-10 in LSRFR<sup>1</sup>)

	With Dam	Low NED	High Ned
<b>General Recreation</b>			
Reservoir Recreation	<b>(\$31.60)</b>		
Low Use Estimate		\$36.18	\$150.12
Middle Estimate 1 (LSRFR)		\$36.90	\$192.70
Middle Estimate 2 (LSRFR)		\$59.50	\$310.50
California Adjusted Estimate		\$180.66	<b>\$942.17</b>
High Use Estimate		\$367.18	\$1,523.74
<b>Angling</b>			
Resident and Steelhead	\$2.07	\$5.20	\$13.84
Steelhead-Tributaries	\$17.73	\$3.36	\$30.90
Salmon-Tributaries	\$151	\$1.22	\$481
Total Recreational Fishing	\$19.96	\$8.68	<b>\$45.23</b>
<b>General Recreation and Angling</b>			
Total Reservoir	\$51.56	\$8.68	
Total Middle Estimate 1		\$13.98	\$206.33
Total Middle Estimate 2		\$36.58	\$324.13
<b>Point Estimate</b>			<b>\$955.80</b>

If these values were converted to 2015 dollars, the point estimate for recreation \$1.39B, assuming an annual average equivalent over 100 years at a 6.875% discount rate.

Table 7. Summary of Recreation @6.875%, (Values in Millions, 2015 USD) (Updating Table 3.2-10 in LSRFR<sup>1</sup>)

	With Dam	Low NED	High Ned
<b>General Recreation</b>			
Reservoir Recreation	<b>(\$45.95)</b>		
Low Use Estimate		\$52.61	\$218.29
Middle Estimate 1 (LSFR)		\$53.66	\$280.21
Middle Estimate 2 (LSFR)		\$86.52	\$451.50
California Adjusted Estimate		\$262.70	<b>\$1,370.02</b>
High Use Estimate		\$533.92	\$2,215.69
<b>Angling</b>			
Resident and Steelhead	\$3.01	\$7.56	\$20.13
Steelhead-Tributaries	\$25.78	\$4.89	\$44.94
Salmon-Tributaries	\$220	\$1.77	\$699
Total Recreational Fishing	\$29.02	\$12.63	<b>\$65.77</b>
<b>General Recreation and Angling</b>			
Total Reservoir	\$74.97	\$12.63	
Total Middle Estimate 1		\$20.33	\$300.02
Total Middle Estimate 2		\$53.20	\$471.32
<b>Point Estimate</b>			<b>\$1,389.84</b>

## Areas for Further Research

### Discount Rate

The discount rate used in the 1999 LSRFR was set by the USACE at 6.875%. The discount rate is only applied to recreation benefits in the future, and not to current reservoir recreation benefits. The LSRFR does provide estimates at 4.75% discount rate (BPA Rate) and at 0.0% discount rate (Tribal Rate) but are provided purely for ornamental purposes and are not used in the final analysis. The 2015 Federal discount rate to be followed by the Army Corps of Engineers is set at 3.375%.

Discount rates are typically applied to capital investments to predict the net present value of future cash flows. These are sometimes called private discounting; discounting from the specific, limited perspective of private individuals or firms and their financial capital decisions.<sup>11</sup> On the other hand, social discounting reflects the broad society-as-a-whole point of view and is many times favored in projects with long time horizons in order maintain intergenerational equity and environmental justice concerns.<sup>12</sup> When discounting future consumer benefits from recreation, the implication made is that recreation benefits will not be worth as much in the future as they are today, i.e., people will value their recreational experiences at a discounted rate. In this valuation, the high discount rate used creates a bias in the values towards 'current' dam recreation and disadvantages free-flowing river recreation which begins to be valued twenty years in the future. Weighting future generations less than

current generations is considered unethical, as it does not give a voice to those that may be affected in the future.

There has been much debate surrounding discount rates. In order to help solve this dilemma, Congress has set the discount rate for water resource agencies to use when evaluating water resource projects. These discount rates are set annually, by law (Section 80 of PL 93-251) and are based on the cost of government borrowing.<sup>13</sup> As stated earlier, the 2015 federal discount rate is set at 3.375%.

## Regional Economic Development

Regional economic development (RED) should be reevaluated as different industries recirculate money within a local economy at different rates. Money in recreation and tourism industries tends to recirculate within the economy at a higher rate than many other industries, such as movie theaters or restaurants.<sup>14</sup> As a result of recreation economies having a diverse economic makeup there is more spending, and more spending means more income, jobs, and taxes.

## Ecosystem Service Values

Ecosystem services are defined as the benefits people derive from nature, free of charge. Breathable air, drinkable water, nourishing food, waste treatment, flood risk reduction, and stable atmospheric conditions are some examples. These benefits are conventionally not accounted for in accounting or economic contribution/impact analyses. In reality, ecosystem services create irreplaceable value and can amount to high cost savings and increased economic value to the state and the communities around the Lower Snake River.<sup>15</sup> In order to show their economic importance, ecosystem services can be valued in dollar units. In many cases these values reflect avoided costs, inputs into economic production processes, or into potentially marketable goods and services. Economists have developed a number of methods to translate ecosystem services into monetary values. A list of the most common valuation methodologies is provided in Appendix B.

In the absence of primary data for a site-specific valuation, values obtained from already published studies of sufficiently similar sites can be used as general approximations. This valuation methodology is referred to as benefit transfer. It is commonly applied in policy analysis, as decision makers require timely and cost-effective methods for valuing green spaces.

The following are just a few examples of ecosystem services present in the Lower Snake River Basin, which have not been valued and should be considered for valuation.

### **Aesthetic Information**

Aesthetic Information is defined as enjoying the sights, sounds, smells, and presence of nature. This ecosystem service is often valued through the environmental attributes of property sales and hence reflects the added housing value to those who live close to outdoor recreational areas. As outdoor recreational areas expand with the removed dam, aesthetic values are expected to increase.

### **Wildlife Habitat**

Recreational activities like wildlife viewing or hunting would not exist without the ecosystem service of habitat and nursery. Beyond recreation, however, ecosystems also provide safe havens for endangered species and other species important in food webs and in other ecological functions. In some cases, people value the existence of wildlife as an end in itself (intrinsic value of wildlife). Restoring the natural areas around the Lower Snare River is expected to benefit many water and land species, increasing the habitat value of the area. It should also be noted that “wildlife viewing” was the most lucrative outdoor recreation activity in Washington State.<sup>16</sup>

### **Water Quality**

The Lower Snake River Basin has many rivers, lakes, and watersheds within it. The vegetated landscape around these water bodies plays an important function in improving or maintaining water quality, which eventually affects downstream users as well. Forest and grassland vegetation along riverbanks stabilize soils and prevent erosion, reducing sediment run-off. Vegetation, microbes, and soils remove pollutants and sediment from the water by adhering to contaminants, by reducing water speed to enhance infiltration, by biochemical transformation of nutrients and contaminants, by absorbing water and nutrients from the root zone of trees, by stabilizing eroding banks, and by diluting contaminated water.<sup>17</sup> Some species are able to provide clean water by removing pollutants and sediment from the water. It can be said that natural lands filter and control the flow of water in lieu of built infrastructure like water purification facilities, levies, and storm water systems. The cost of replacing these functions with built infrastructure, or replacement value, is one way to value water quality.

### **Inclusion of Passive Use Values**

Passive use values, also referred to as “non-use” values, are values that are not associated with actual use of an ecosystem or its services.<sup>18</sup> For example, a person may be willing to pay to preserve an ecosystem even though they themselves may never visit it. This person values it just to know it exists. Passive use values are not included in the point estimates for a free-flowing Lower Snake River. The original studies include passive use values, but they are not used in the final BCA.<sup>19</sup>

## **Conclusion**

This analysis has found that the most accurate point estimate for recreation on a free-flowing Lower Snake River is \$956M (1998 dollars, 1.4B in 2015 dollars) per year assuming an annual average equivalent over 100 years at a 6.875% discount rate. This estimate assumes visitation by survey respondents stating they 'definitely' or 'probably' would visit, applying this ratio to non-responders, and NED values derived from a well-conducted survey.

## **Appendix A: A Primer on Value Measures: Economic Benefits and Beneficiaries**

Economic benefits are a measure of the total change in social welfare, including market and non-market values. Market values refer to existing markets and recorded expenditures whereas non-market values refer to benefits obtained free of charge. Economic beneficiaries are those who gain welfare, or the economic benefits being measured. In this current scenario, the main beneficiaries are the communities along the Lower Snake River who are assumed to make up the largest percentage of visitors. If the dams were to be breached, beneficiaries would expand to more than just current reservoir users, such as businesses or long distance travelers looking for unique recreation opportunities.

The DREW Recreation Workgroup focused on two types of recreation activities that would occur on the Lower Snake River in all scenarios: angling and general recreation (non-angling water specific recreation which changes from one scenario to the other). General recreation specific to the reservoirs is boating and water skiing. If the four dams were to be breached, general recreation activities would expand to include drift boating, rafting, kayaking, and jet boating in addition to nature and wildlife viewing, hiking, and camping.

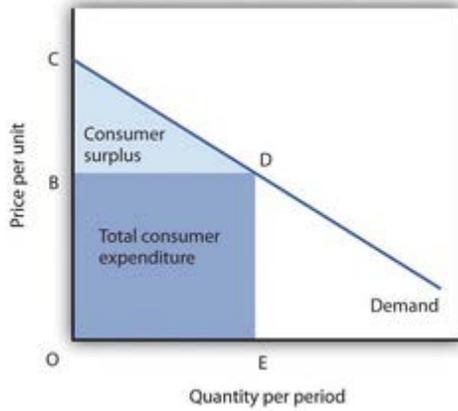
The recreation values used to measure the benefits derived from these activities reflect welfare gains or losses, beyond market transactions, obtained from the set of recreational opportunities available to people. Expenditures on recreational activities are used to estimate demand and willingness to pay for recreational activities. In this case these economic benefits represent consumer surplus values, or people's willingness to pay for recreation.

### **NED Values and Consumer Surplus**

National economic development, or NED values, illustrates the net effects or changes in the economic value of the national output of goods and services. NED benefits do not show the gains made in one region at the expense of another region. It is assumed in the LSRFR that if there is demand for certain types of recreation, that demand will be met within the country in one location or another. In this report, NED recreation values are measured in terms of consumer surplus or net willingness to pay (WTP).

Consumer surplus is the difference between the maximum price consumers would be willing to pay for a good or service and what they actually pay for it (see **Figure 1**). This difference is a gain for the consumer since they are paying less than the value they place on that benefit. For example, a Washingtonian may be willing to pay \$50 to go hiking for one day on the Olympic Peninsula (this would be point C in Figure 14). If the actual cost of the hiking trip is only \$20 (point D), then the hiker gains a net economic benefit (consumer surplus) of \$30 per day (or the area of the triangle BCD). Even though they are obtained free of charge, the existence of extra benefits is strategic in the decision to visit an attraction or engage in an activity.

Figure 1. Consumer Surplus



## Appendix B Ecosystem Services and Valuation Methodologies

### Typology for 21 Ecosystem Services

Good/Service	Economic Benefit to People
<b>Provisioning Services</b>	
Food	Producing crops, fish, game, and fruits
Medicinal Resources	Providing traditional medicines, pharmaceuticals, and assay organisms
Ornamental Resources	Providing resources for clothing, jewelry, handicraft, worship, and decoration
Energy and Raw Materials	Providing fuel, fiber, fertilizer, minerals, and energy
Water Supply	Provisioning of surface and groundwater for drinking water, irrigation, and industrial use
<b>Regulating Services</b>	
Biological Control	Providing pest and disease control
Climate Stability	Supporting a stable climate at global and local levels through carbon sequestration and other processes
Air Quality	Providing clean, breathable air
Moderation of Extreme Events	Preventing and mitigating natural hazards such as floods, hurricanes, fires, and droughts
Pollination	Pollination of wild and domestic plant species
Soil Formation	Creating soils for agricultural and ecosystems integrity; maintenance of soil fertility
Soil Retention	Retaining arable land, slope stability, and coastal integrity
Waste Treatment	Improving soil, water, and air quality by decomposing human and animal waste and removing pollutants
Water Regulation	Providing natural irrigation, drainage, groundwater recharge, river flows, and navigation

Supporting Services	
Habitat and Nursery	Maintaining genetic and biological diversity, the basis for most other ecosystem functions; promoting growth of commercially harvested species
Genetic Resources	Improving crop and livestock resistance to pathogens and pests
Cultural Services	
Natural Beauty	Enjoying and appreciating the presence, scenery, sounds, and smells of nature
Cultural and Artistic Inspiration	Using nature as motifs in art, film, folklore, books, cultural symbols, architecture, and media
Recreation and Tourism	Experiencing the natural world and enjoying outdoor activities
Science and Education	Using natural systems for education and scientific research
Spiritual and Historical	Using nature for religious and spiritual purposes

**Source:** Adapted from de Groot puc., 2002 and Sukhdev et al., 2010

### Primary Ecosystem Service Valuation Methods

Market Value	The value that an ecosystem good is sold for in a market.
Avoided Cost (AC)	The value of costs avoided that would have been incurred in the absence of particular ecosystem services. Example: The hurricane protection that is provided by barrier islands avoids property damages along coastlines.
Replacement Cost (RC)	The cost of replacing ecosystem services with man-made systems. Example: Natural water filtration is replaced with a costly man-made filtration plant.

Factor Income (FI)	The enhancement of income by ecosystem service provision. Example: Water quality improvements increase commercial fisheries catch and thereby also the incomes of fishermen.
Travel Cost (TC)	The cost of travel required to consume or enjoy ecosystem services. Travel costs can reflect the implied value of the service. Example: Recreational areas attract tourists. The value they place on that area must, at a minimum, be at least the price they were willing to pay to travel to it.
Hedonic Pricing (HP)	The reflection of service demand in the varying prices people will pay for associated goods. Example: Housing prices of properties in close proximity to recreational areas can be higher than those that are farther from these areas.
Contingent Valuation (CV)	The value for service demand elicited by posing hypothetical scenarios that involve some valuation of land use alternatives. Example: People would be willing to pay for increased wetland restoration, as expressed through surveys.
Group Valuation (GV)	Discourse-based contingent valuation, which is conducted by bringing together a group of stakeholders to discuss values in order to determine society's willingness to pay. Example: Government, citizen's groups, and businesses come together to determine the value of an area and the services it provides.

### Appendix C: Changes in Ranking of Recreational Activities

This chart shows gains and losses in popularity of recreational activities in Washington State. Many of the recreational activities that would expanded or gained from a free flowing Lower Snake River have gained in popularity in recent years, e.g., fishing, hiking, floating, camping.

**Table 3.19a: Changes in Rankings of Activities.**

Activity	2002 Rank	2006 Rank	2012 Rank	Difference in rank from 2002 to 2012	Difference in rank from 2006 to 2012	Difference in rank: mean of 2002 and 2006 rankings compared to the 2012 ranking	
Fishing for shellfish	39	45	29	10	16	13	Greatest gain in ranking 
Visiting a nature interpretive center	20	33	14	6	19	12.5	
Climbing or mountaineering	49	42	34	15	8	11.5	
Firearms (hunting or shooting)	22	41	21	1	20	10.5	
Inner tubing or floating	42	25	23	19	2	10.5	
Camping—backpacking/primitive location	46	47	36	10	11	10.5	
Snowshoeing	52	52	44	8	8	8	
Softball	48	40	37	11	3	7	
Camping—tent camping with car/motorcycle	26	19	16	10	3	6.5	
Volleyball	43	34	32	11	2	6.5	
Hiking	8	16	6	2	10	6	
Aerobics or fitness activities, but not weights—at a facility	33	13	17	16	-4	6	
Water skiing	40	49	39	1	10	5.5	
Fishing from a bank, dock, or jetty	17	31	19	-2	12	5	
Beachcombing	21	14	13	8	1	4.5	
Picnicking, BBQing, or cooking out	9	1	1	8	0	4	
Horseback riding	34	50	38	-4	12	4	
Wildlife viewing/photographing	2	11	3	-1	8	3.5	
Boating—canoeing, kayaking, rowing, manual craft	38	28	30	8	-2	3	
Badminton	53	43	45	8	-2	3	
Fishing from private boat	19	30	22	-3	8	2.5	
Jogging or running	15	12	12	3	0	1.5	
Snowboarding	41	46	42	-1	4	1.5	
Weight conditioning—at a facility	24	18	20	4	-2	1	
Tennis	32	36	33	-1	3	1	

Source: Washington SCORP 2015

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